LLNL TPCs

Mike Heffner

February 5, 2014

Long History of TPCs at LLNL

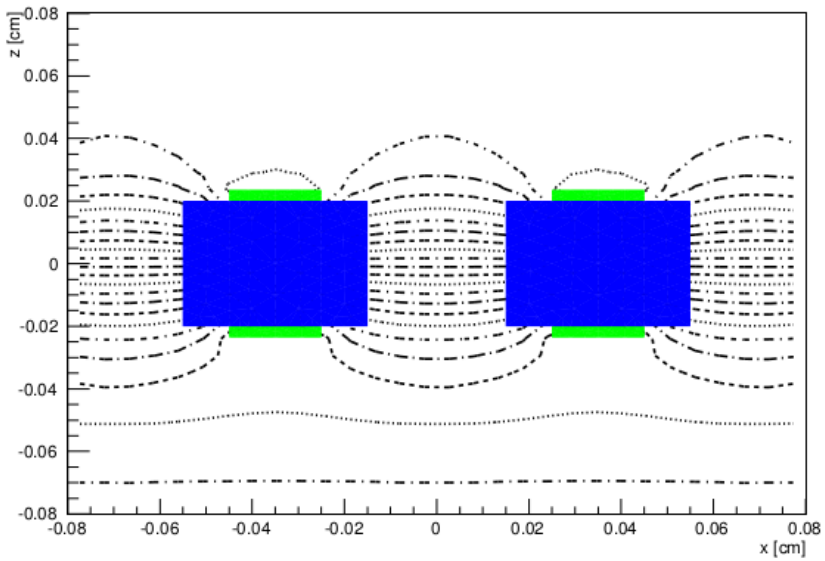
- **E910/E895** AGS, Au+Au and p+Au collisions EOS-TPC
- **E907 (aka MIPP)** FNAL Booster, p+Au collisions EOS-TPC
- **nTPC** neutron TPC, locate sources of neutrons, custom built
- **fissionTPC** Make high-accuracy cross section measurements of actinides, custom built
- **nEXO** Just starting, next generation
- **neg Ion TPC** Reach the intrinsic energy resolution limit, development TPC
- **LUX** Dark matter, dual phase. Collaboration member and some subsystems
- **Cohearant ν scatter** Measure this unseen reaction, development TPC
- **Others...(pre-history)**, STAR TPC, FTPC, EOS-TPC, xenon Compton camera, ...

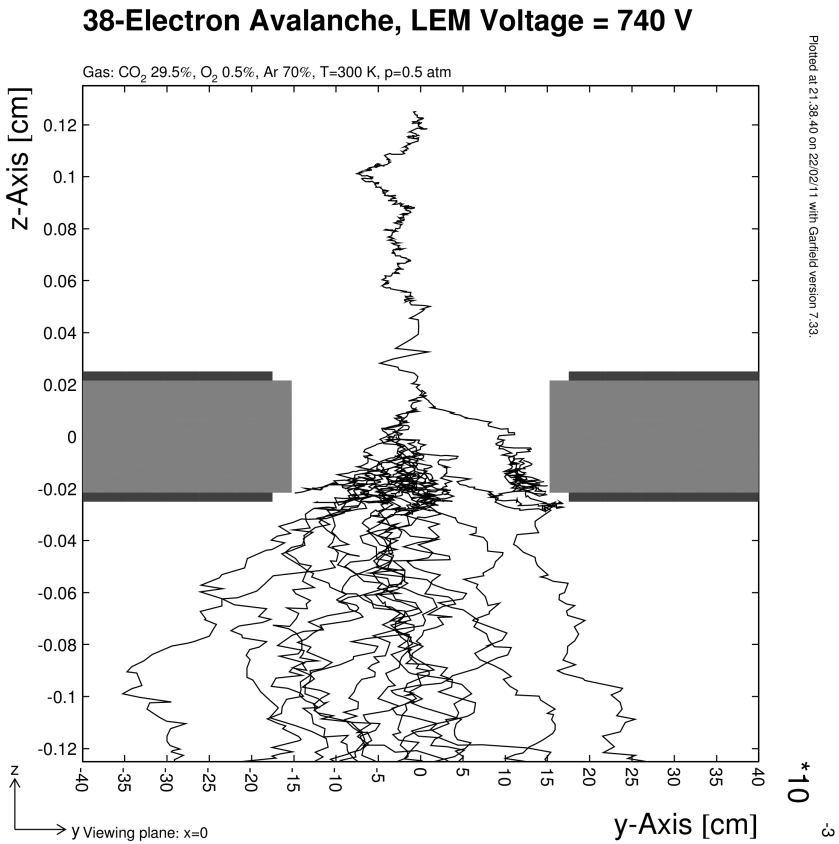
Workforce

- Many of the physicists that worked on these projects are still at LLNL
- We have many engineers
  - Mechanical (e.g. Phenix Magnet: Bob Yamamoto, Joel Bowers)
  - Electrical (e.g. fissionTPC electronics: Vincent Riot)
  - Project Management
  - Many subfield special engineering labs and expertise
- Techs
  - Mechanical Drawing/Design
  - Machine shops
  - PCB layout
  - Electronics assembly (0201's common. 0.4 mm pitch connectors common.)
- Experience with what is better done in industry, PCB fab/loading, simple machining, etc...

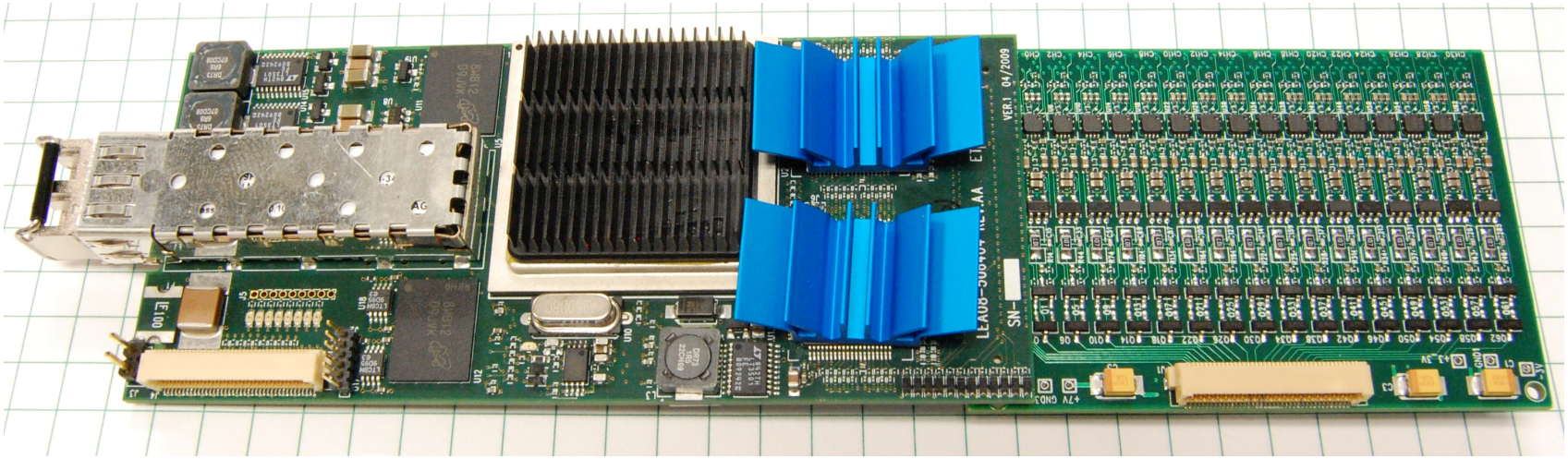
Examples of Relevant LLNL TPC Hardware Field Simulations

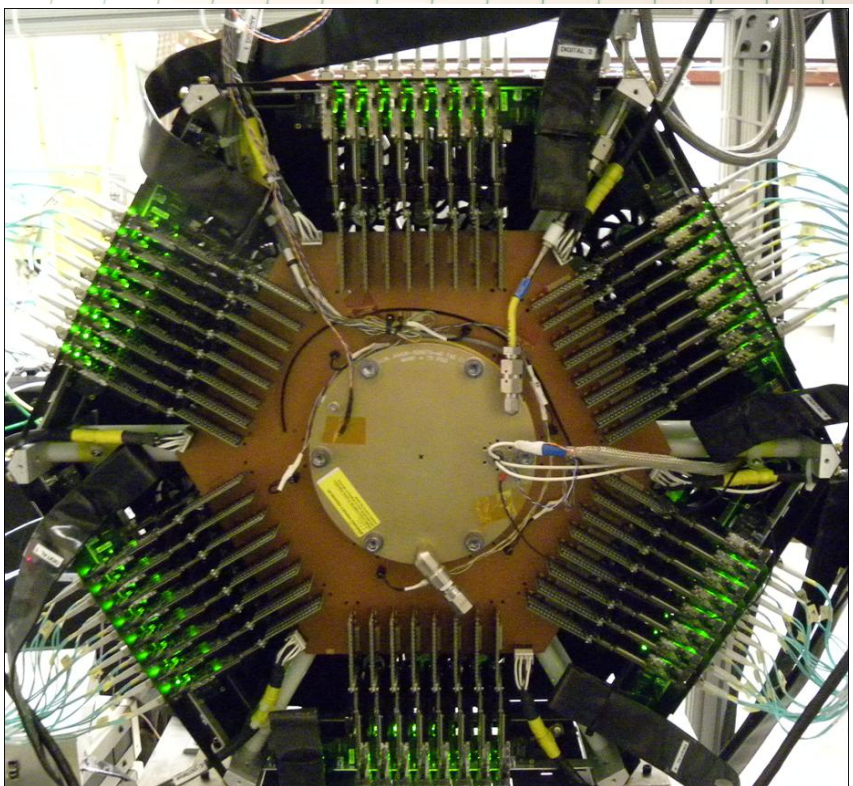
Elmer and Garfield Simulations of a LEM



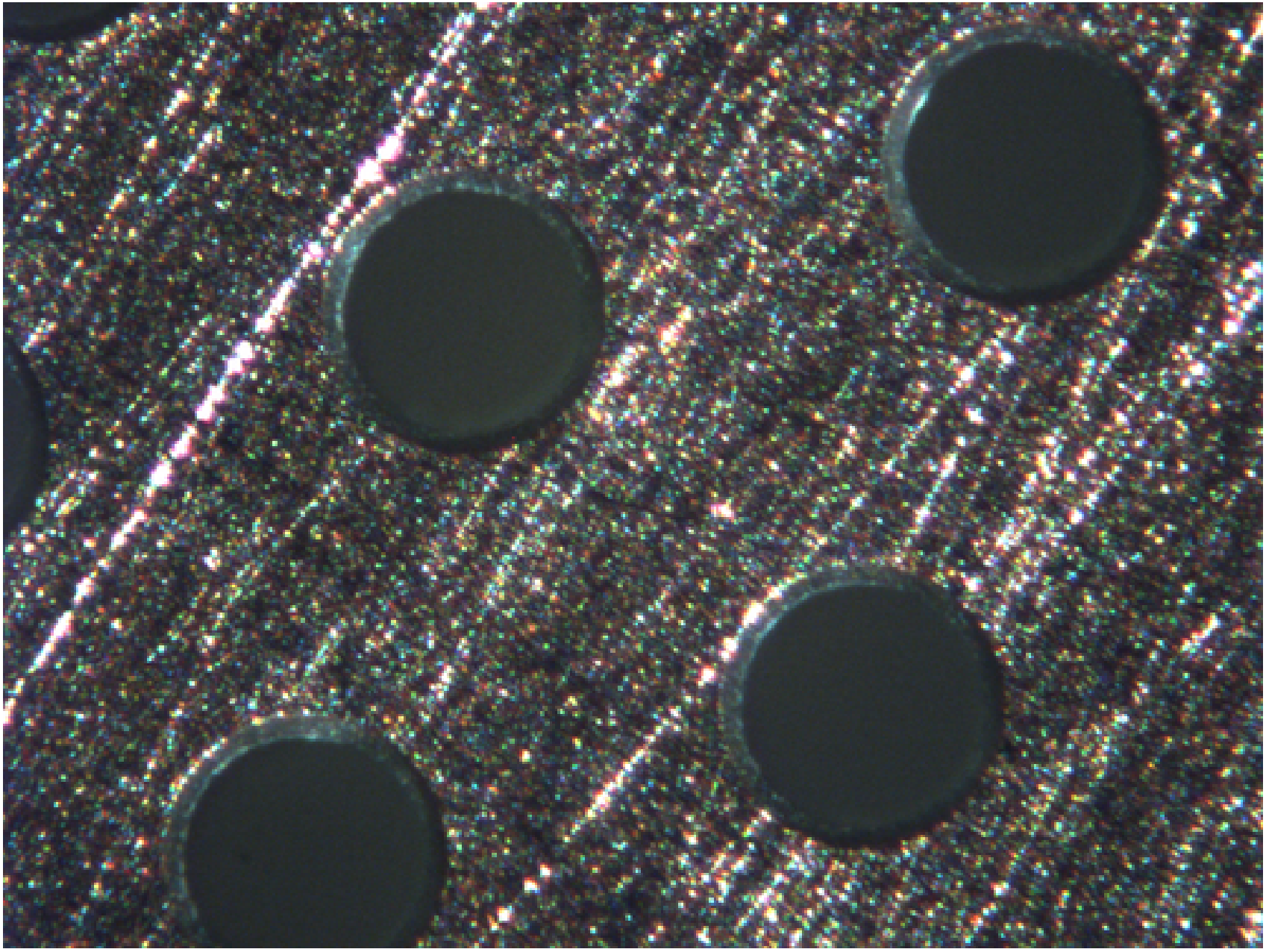


Examples of Relevant LLNL TPC Hardware Electronics

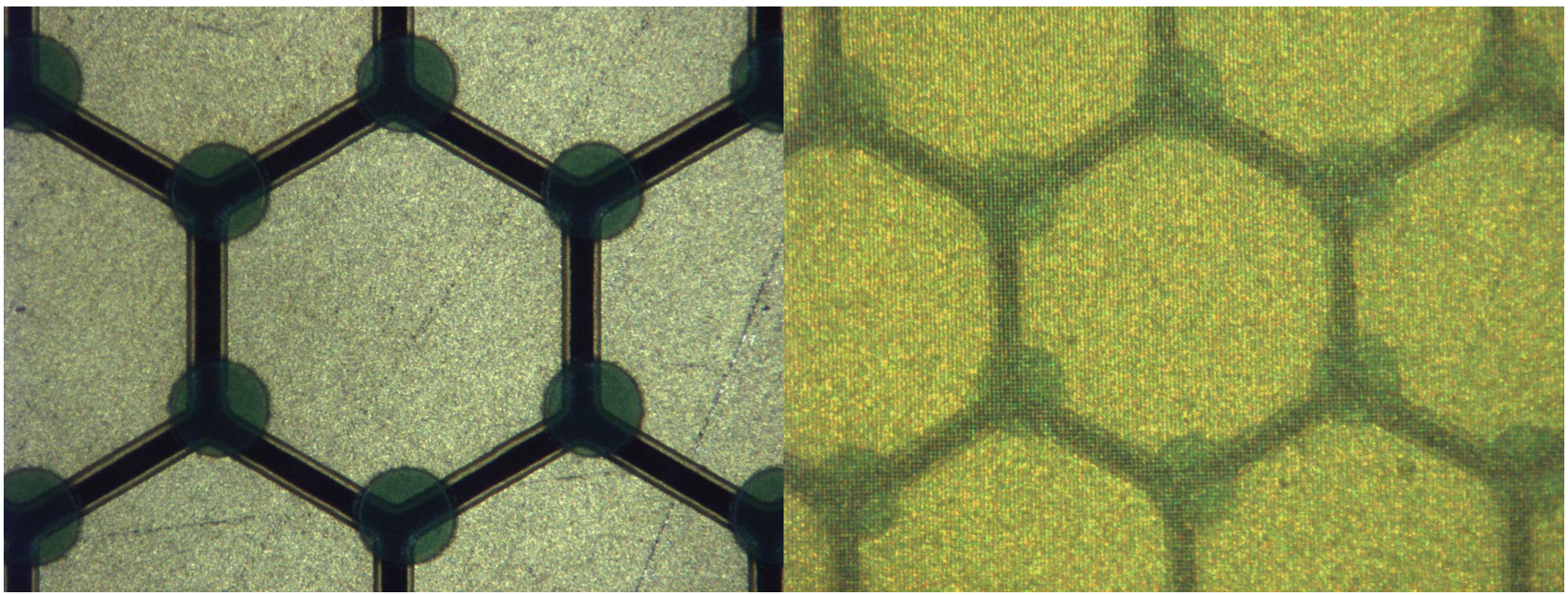




Examples of Relevant LLNL TPC Hardware
Micro-structure Gas Gain – LEM



Examples of Relevant LLNL TPC Hardware
Micro-structure Gas Gain –MICROMEGAS



Some Suggestions the Next Steps for a Phenix TPC

- Develop a specifications and requirements document
- Identify key design decisions, study them, document each one
- Derive a basic WBS (from the the S&R doc and list of key design decisions) and from that a bottom up cost and schedule
- Identify risks, prioritize and develop studies/experiments to reduce risk
- Iterate

Some Key Design Decisions

- One or two volume
- Assembly: split or pull beam pipe through (also assemble in or out of IR)
- ID and OD, and eta coverage. Nail down allowable envelope, TPC and services.
- Pad geometry (rectangle, hex, chevron, etc..), size(as function of r), total number
- Gain uniformity requirement
- Acceptable ion feedback
- Aging: required total charge lifetime
- Gas mixture
- gas gain: wire, GEMs, LEMs, MICROMEGAS, combination.
- Acceptable field cage and end plate areal density
- Thermal requirements
- Field cage electric field uniformity requirement
- What calibrations are needed